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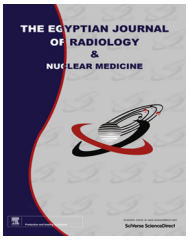

ORIGINAL ARTICLE

Lung ultrasonography in evaluation of neonatal respiratory distress syndrome

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KEYWORDS

Respiratory distress syndrome (RDS);
Neonate;
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Abstract *Objectives:* To evaluate diagnostic ability of lung ultrasonography (LUS) in detection of pulmonary manifestations of neonatal respiratory distress syndrome as well as follow up the response to treatments.

Patients and methods: One hundred neonates with clinical and radiographic signs of respiratory distress (RDS) were included in this prospective study. LUS was done using both a transthoracic and a transabdominal approach within the first 24 h of life and after that for detection of pulmonary manifestations and follow up the response to treatment. LUS findings were compared with chest radiography findings.

Results: In comparison with chest X-ray the LUS had sensitivity 98% and specificity 92% in detection of pulmonary manifestations of RDS. In follow up to response of treatment the LUS had 100% sensitivity and 94% specificity.

Conclusion: The LUS can be an alternative diagnostic imaging modality for chest X-ray in follow up neonates with RDS and subsequent reduction dose of radiation.

1. Introduction

Respiratory distress syndrome (RDS), also known as hyaline membrane disease is the most common clinical syndrome encountered among neonates treated in neonatal intensive care units (NICU) (1). Of the many complications of prematurity, lung diseases such as RDS and its complications (pulmonary hemorrhage, pneumonia, atelectasis, pneumothorax, air leak syndrome, and bronchopulmonary dysplasia (BPD)), remain the most common cause of neonatal morbidity (2). RDS is a disease of hypoventilation and a manifestation of pulmonary immaturity and surfactant deficiency. Surfactant usually coats the alveoli and prevents atelectasis by lowering surface tension. In respiratory distress syndrome, the lungs are poorly compliant with acinar atelectasis, and there is a gradual development of thickening of the interstitium and dilatation of the terminal airways (3).

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Neonatal respiratory disease is currently diagnosed on the basis of clinical signs and plain chest X-ray (CXR) (4). RDS is typically presented with tachypnea, expiratory grunting, nasal flaring, cyanosis, substernal and intercostal retractions (5). On plain X-ray chest radiography there is reticulogranular or ground glass opacification, progressive hypo-aeration and air bronchograms (Fig.1). Radiological abnormalities correlate well with the clinical severity. Symptoms and radiological signs progress during the first 6 h of life, and in mild to moderate disease, the granular densities persist for 3–5 days, clearing from peripheral to central and upper to lower lungs (3). The risk of the effects of ionizing radiation (IR) is higher the younger the child is; with the same dose of ionizing radiation (IR), a 1-year-old child is 10–15 times more at risk of developing carcinoma than an adult (6–8). Clinical staging of the RDS using the Clinical Risk Index for Babies (CRIB) score (9) correlated with the 4-stage radiographic scale (10) (Table 1). Reduction of the dose of (IR) is one of the main goals of pediatric radiology. Thus, the continuous search for the balance between the potential benefits and the potential delayed adverse effects, which may arise from the use of diagnostic procedures based on IR, is inevitable when working with children. Ultrasound imaging is increasingly being used as a non-invasive routine procedure at NICUs for the diagnosis of the central nervous system, abdominal cavity, heart, and hip joints. It has the advantage over X-rays that it does not expose the infant to ionizing radiation. Recently few studies evaluated the use of lung ultrasound in the evaluation of neonatal RDS.

Fig. 1 Plain radiography antro-posterior view on supine position for neonate presented with severs RDS, shows diffuse ground glass opacity of both lungs.

Table 1 Plain radiography staging of RDS (10).

Radiographic stage of RDS	Chest X-ray findings
Stage I	Fine homogenous ground glass shadowing
Stage II	Bilateral widespread air bronchogram
Stage III	Confluent alveolar shadowing
Stage IV	Alveolar shadowing obscuring cardiac border

1.1. Image assessment

Normal transthoracic LUS: the pleura is visualized as a smooth, echogenic periodically horizontal moving line (lung sliding sign), synchronous with respiratory cycle below superficial planes and between the rib images, which represents the sliding of the visceral pleura over the parietal pleura (11). Beneath the pleura the lungs are filled with air, which disables visualization of the lung parenchyma. However, the high acoustic impedance between the visceral pleura and the lung parenchyma results in horizontal artifacts, which are the parallel echogenic lines below the pleural line, equally distanced from one another, and are called A-lines (Fig. 2) (12,13).

Normal trans-abdominal LUS is based on the artifact phenomenon, which occurs within the phrenopulmonic border. In a neonate with normally aerated lungs, a transmitted sound beam is completely reflected by the phrenopulmonic border. After another reverberation against the liver or spleen parenchyma, sound waves are transmitted back toward the phrenopulmonic border and then return to a transducer with subsequent reflection of liver or splenic shadow supradiaphragmatic that so called ''acoustic mirror image phenomenon'', was first described by Cosgrove et al. (14) (Fig. 3).

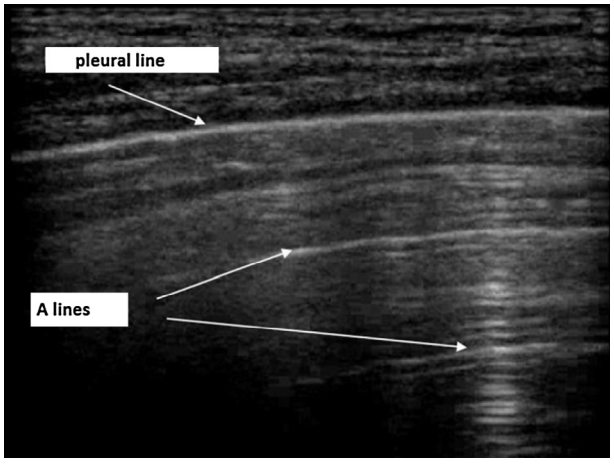

Fig. 2 The normal transthoracic LUS. Transverse scan revealing the ribs and their acoustic shadowing, the pleural line and A-lines.

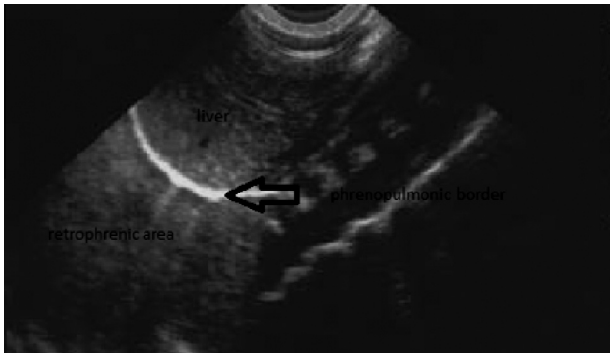

Fig. 3 Normal transabdominal LUS image, no echogenicity in the retrophrenic area can be seen with mirror image in both side of echogenic phrenopulmonic border (arrow).